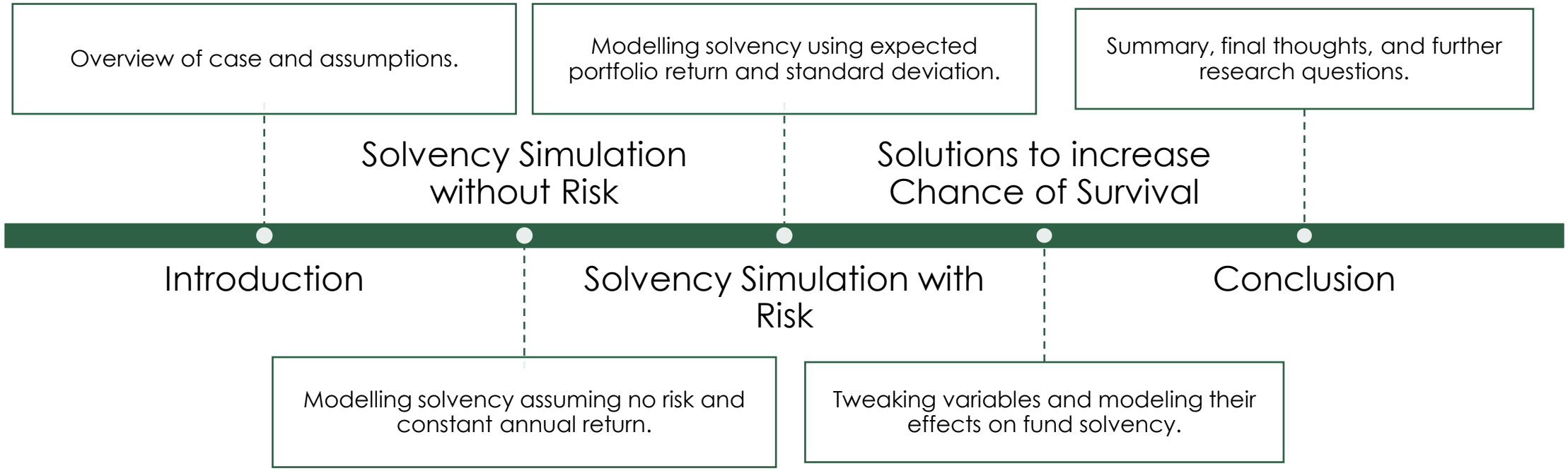
Asset Allocation for the Cook County Pension Fund

Agenda


Overview of case and assumptions.
Modelling solvency using expected portfolio return and standard deviation.
Summary, final thoughts, and further research questions.
Solvency Simulation without Risk
Solutions to increase Chance of Survival
Introduction
Solvency Simulation with Risk
Conclusion
Modelling solvency assuming no risk and constant annual return.
Tweaking variables and modeling their effects on fund solvency.

Case Introduction & Assumptions

Case Overview:

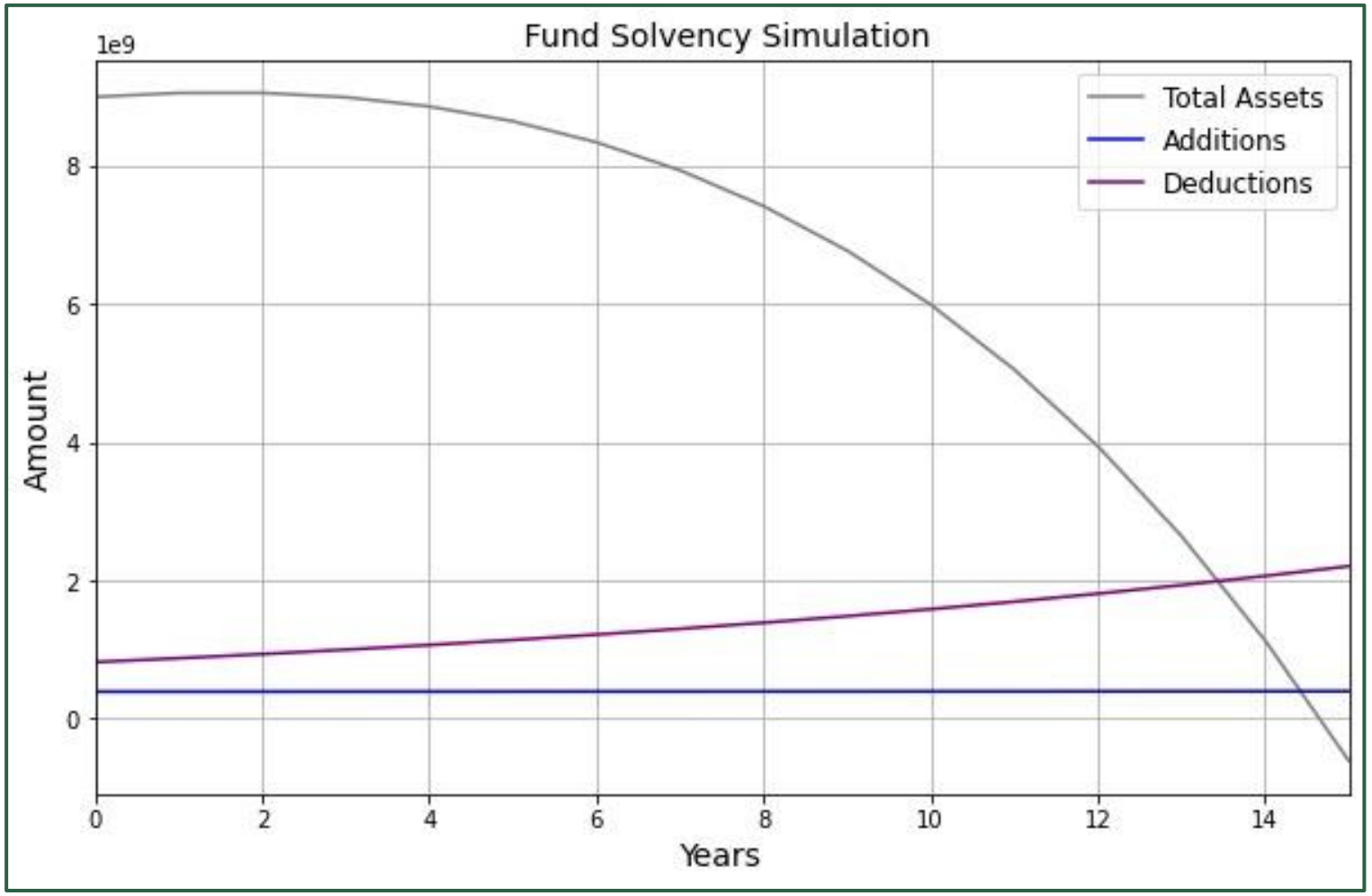
- The Cook County pension fund is woefully underfunded, putting the retirements of its beneficiaries at serious risk.
- The fund is a defined benefit plan with several billion under management.
- Liability growth is rapidly outpacing contribution growth.
- State of Illinois has recently given the fund a ~$270million cash injection.
- Case takes place in 2016.

Relevant Modelling Assumptions:

- Liabilities and additions grow at the constant growth rate based on the portfolio data – unless stated otherwise.
- The portfolio is not rebalanced over time, the weights are based on the 2016 data from the case.
- We assume an alternatives split of 50% private equity and 50% hedge funds.

Solvency Simulation without Risk

- We assume an annual return of 6% and no standard deviation.
- The additions grow at the average growth rate (GR) of 0.1% and liabilities grow at an average of ~6.7%.
- Without adjustments, the fund becomes insolvent after about 15 years.

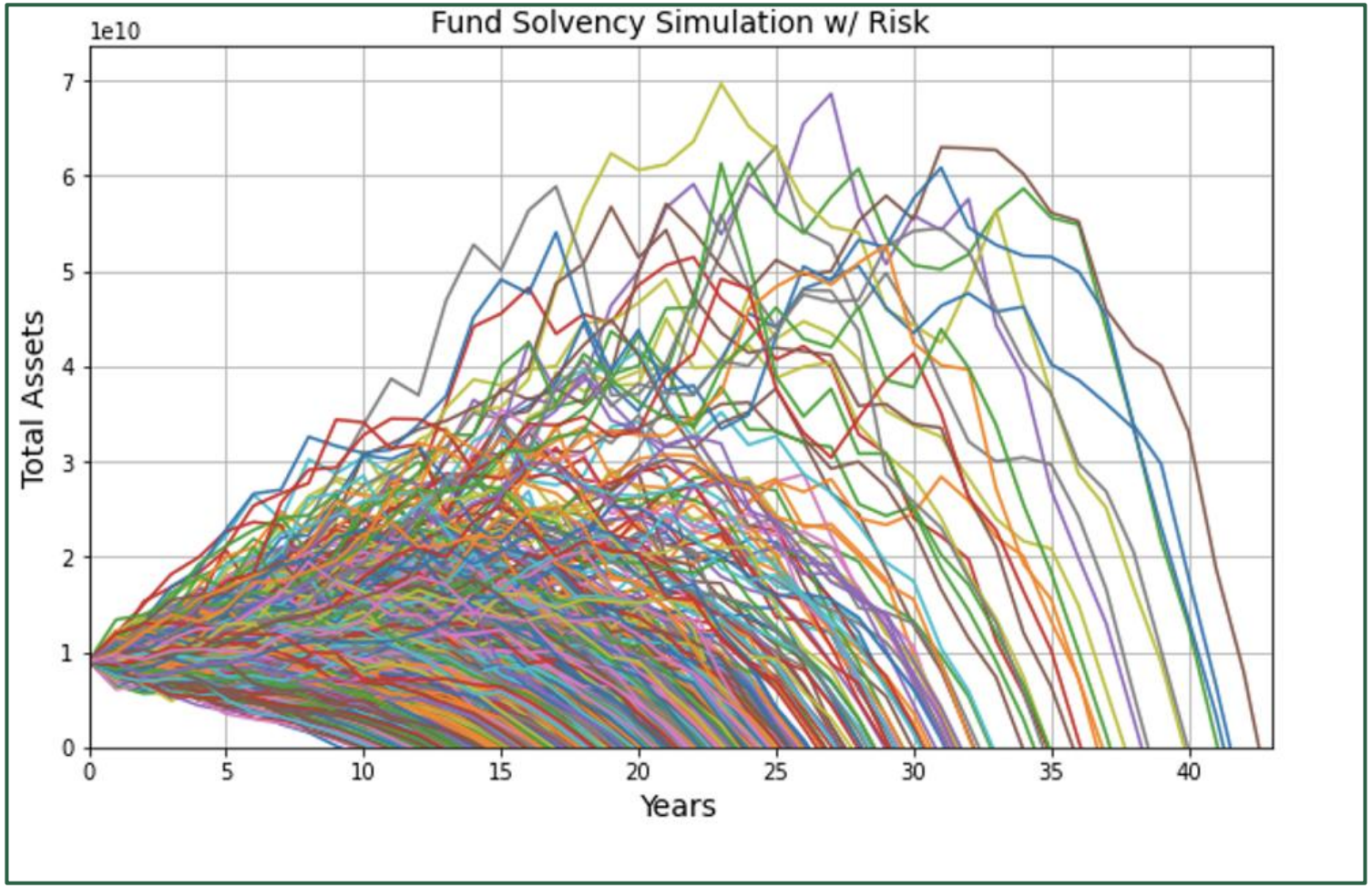


Solvency Simulation with Risk (1000 Sims)

Base Case Sim Results

Year	Survival Rate
2017	100%
2018	100%
2019	100%
2020	100%
2021	100%
2022	100%
2023	100%
2024	100%
2025	100%
2026	100%
2027	100%
2028	99.90%
2029	98.89%
2030	97.19%
2031	92.26%
2032	86.33%
2033	79.30%
2034	70.05%
2035	58.69%

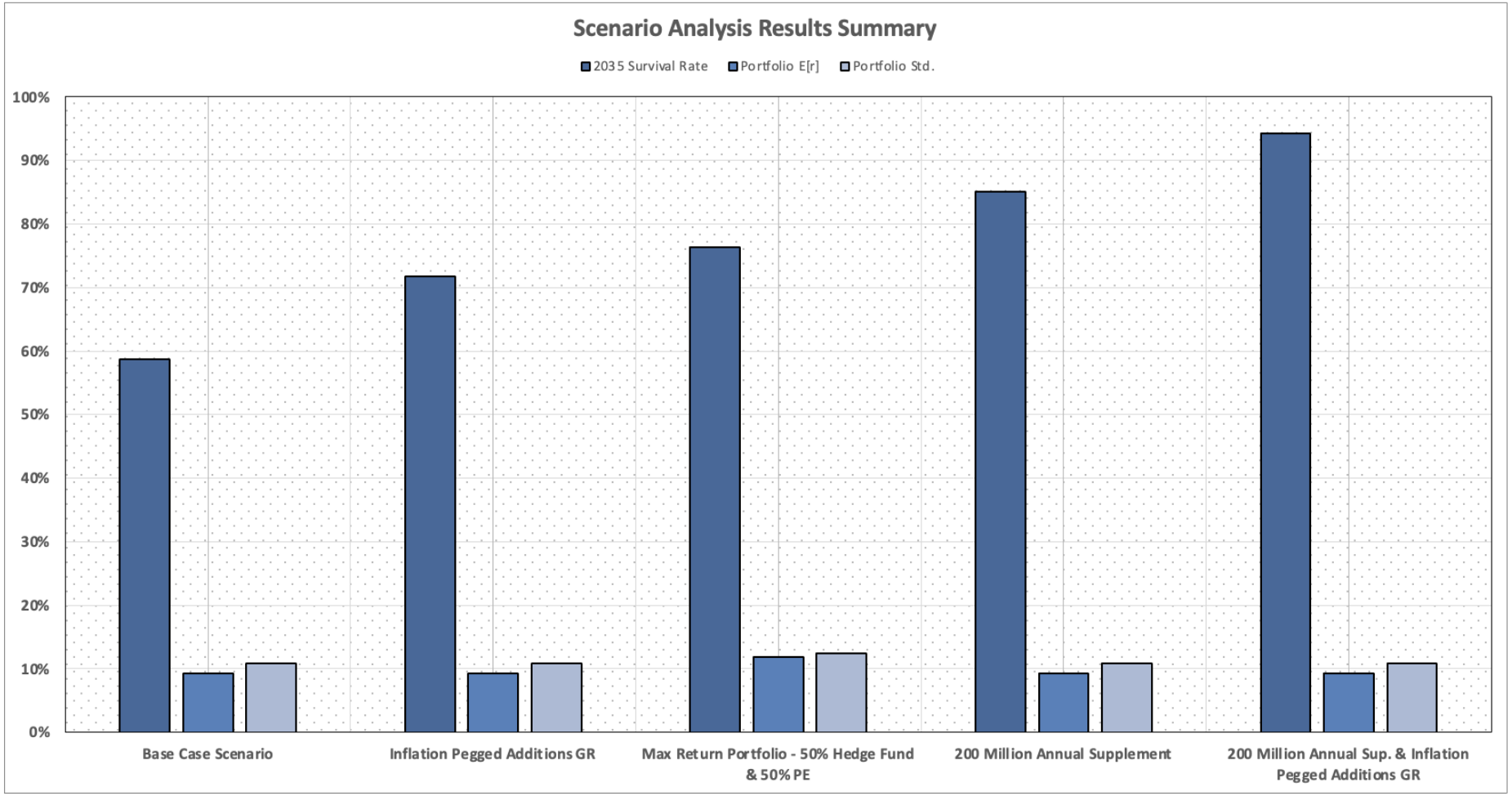
Portfolio Stats	
E[r]	9.34%
Std.	10.88%



Conducting scenario analysis to model solvency impact.

- In order to model potential solutions, we analyze the effects of tweaking various model inputs.
- We assume no cuts in the deductions.
- On the following slide you will see what happens when…
  - the additions GR is pegged to the average inflation rate (~2.97%).
  - the portfolio is rebased using return maximizing solver-based allocations.
    - 100% alternatives – 50% Hedge Funds, 50% Private Equity
  - an annual state-funded supplement of $200 million is made – (assumed perpetual).
  - the fund receives both an annual $200 million supplement and the additions GR is pegged to inflation.

Summary of Scenario Analysis



Increasing additions raises 2035 survival probability more than rebalancing.

- All of our assumed scenarios outperform the base case model.
- Our analysis demonstrates that, given the case's assumptions, increasing capital inflows is the best way to increase long run solvency.
- Rebasing the portfolio's allocations to maximize return is not the best approach and likely isn't worth the added risk.
- While our scenarios increase the chances of solvency through 2035, the fund is still fundamentally unsustainable.
- The assumption of a continued deductions GR of 6.7% is not realistic.

Scenario	2035 Solvency Prob.
Base Case	59%
Inflation Pegged Add.	72%
Max. Return Portfolio	76%
$200 Mil. Annual Sup.	85%
$200 Mil. & Infl. Peg. Add.	94%

Conclusion

- Without significant adjustments, there is a large chance the fund will be insolvent by 2035.
- There are realistic solutions that can significantly increase the fund's probability of solvency.
- Using a more refined model, the fund's insolvency is predicted for 2038 – an improvement from the base case.
- Structural changes in non-investment cash-in/outflows are key to extending the fund's solvency.

Questions to consider

- Are "traditional" pension funds structurally unsustainable in today's world?
- Is it fair to use taxpayer money to bail out a failing pension fund?
- What checks and balances can be put in place to prevent funds from becoming drained?

Appendix

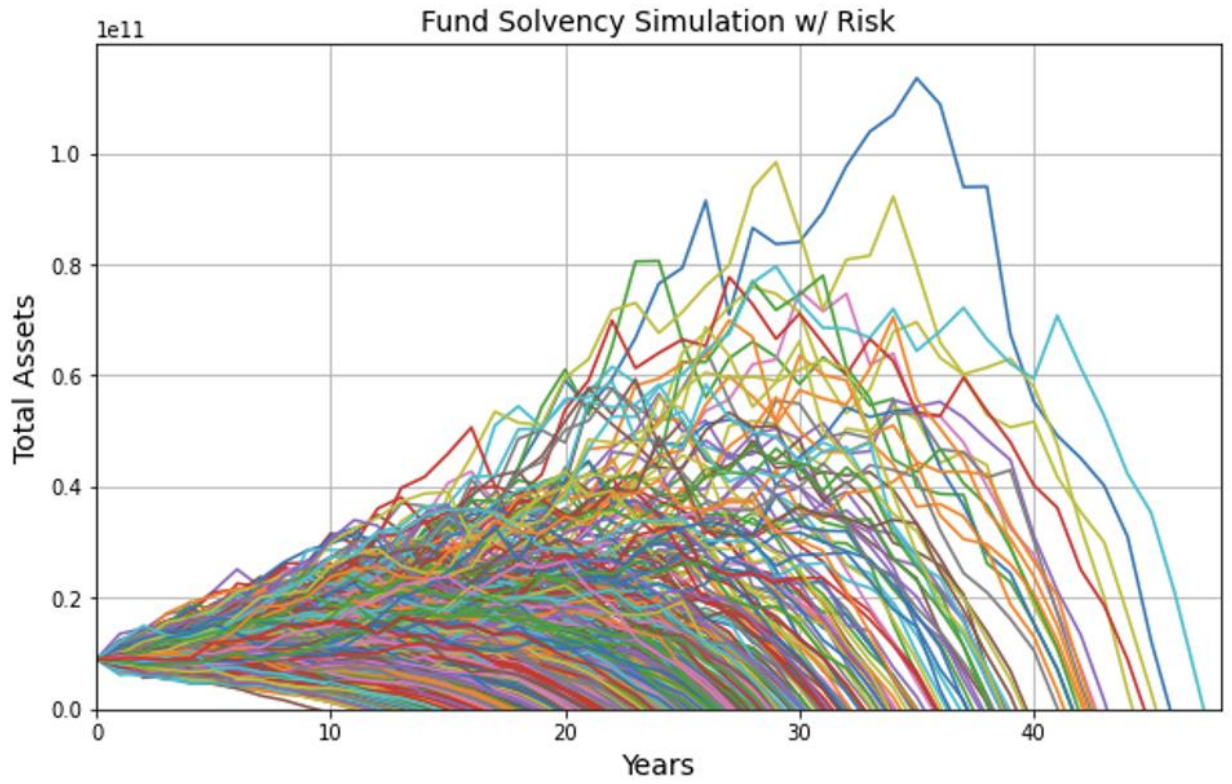
Detailed documentation for the discussed solutions.

Inflation Pegged Additions Growth - Stats

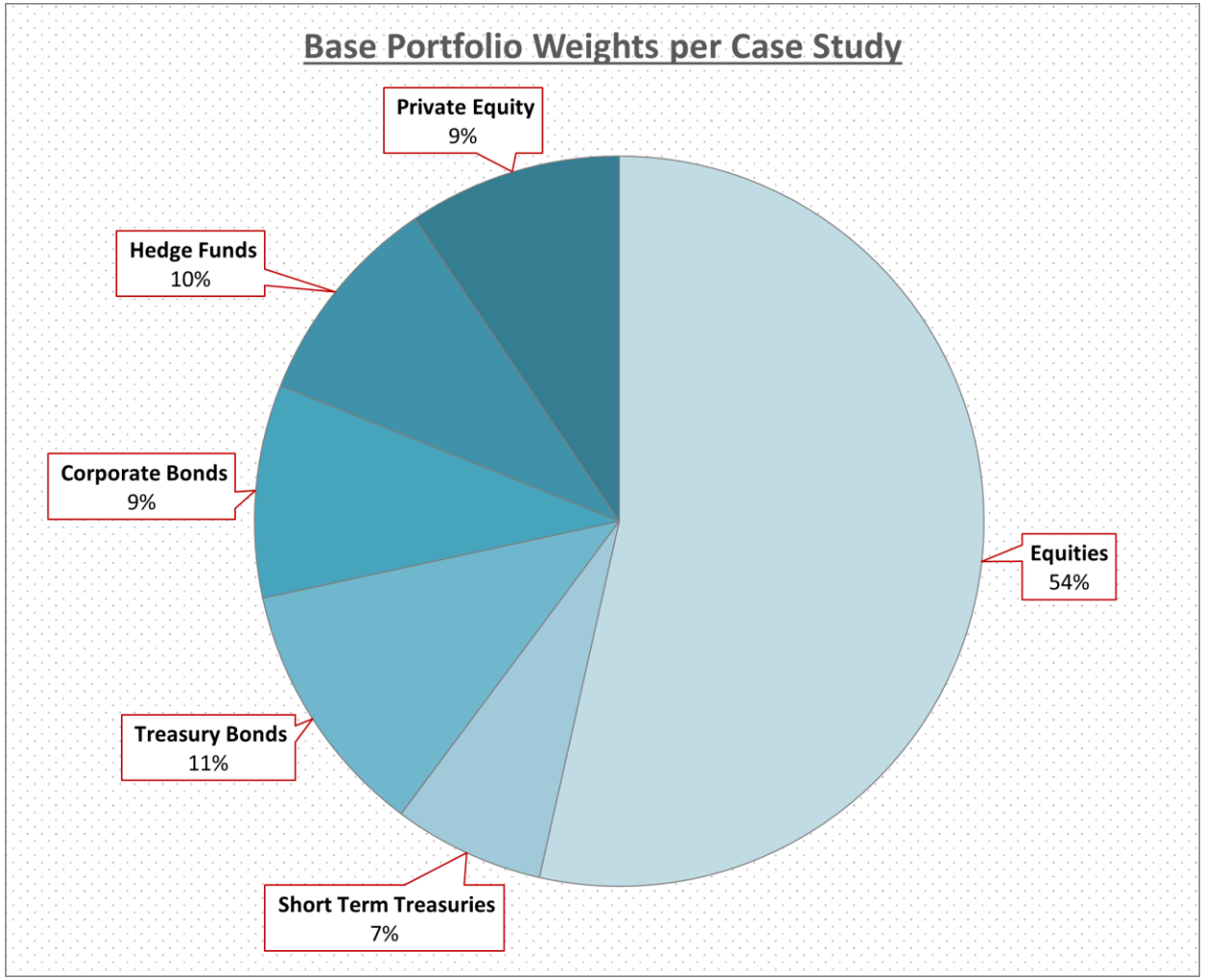
Inflation Pegged Add. GR

Year	Survival Rate
2017	100%
2018	100%
2019	100%
2020	100%
2021	100%
2022	100%
2023	100%
2024	100%
2025	100%
2026	100%
2027	100%
2028	99.90%
2029	99.80%
2030	98.79%
2031	95.98%
2032	92.45%
2033	85.71%
2034	79.78%
2035	71.83%

Portfolio Stats	
E[r]	9.34%
Std.	10.88%



2016 Portfolio Weights per Case Study

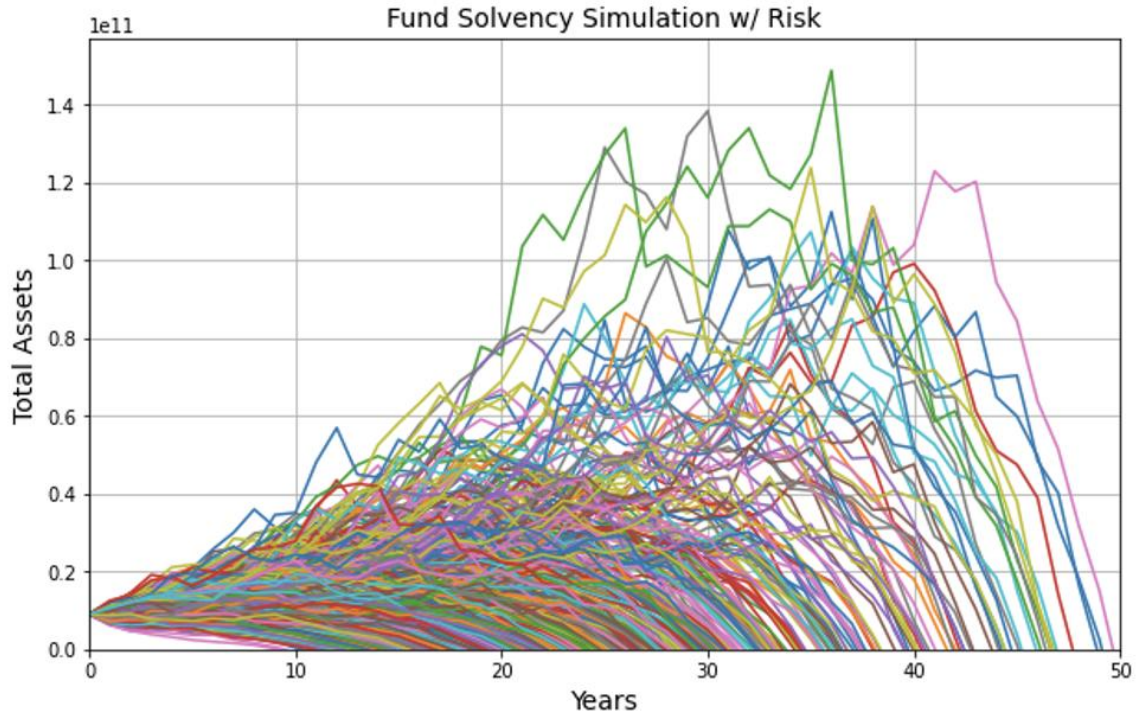


Return Optimized Portfolio - Stats

50% Hedge Fund / 50% PE

Year	Survival Rate
2017	100%
2018	100%
2019	100%
2020	100%
2021	100%
2022	100%
2023	100%
2024	100%
2025	100%
2026	100%
2027	100%
2028	99.70%
2029	99.39%
2030	98.18%
2031	95.91%
2032	91.21%
2033	88.03%
2034	83.33%
2035	76.36%

Portfolio Stats	
E[r]	11.84%
Std.	12.37%

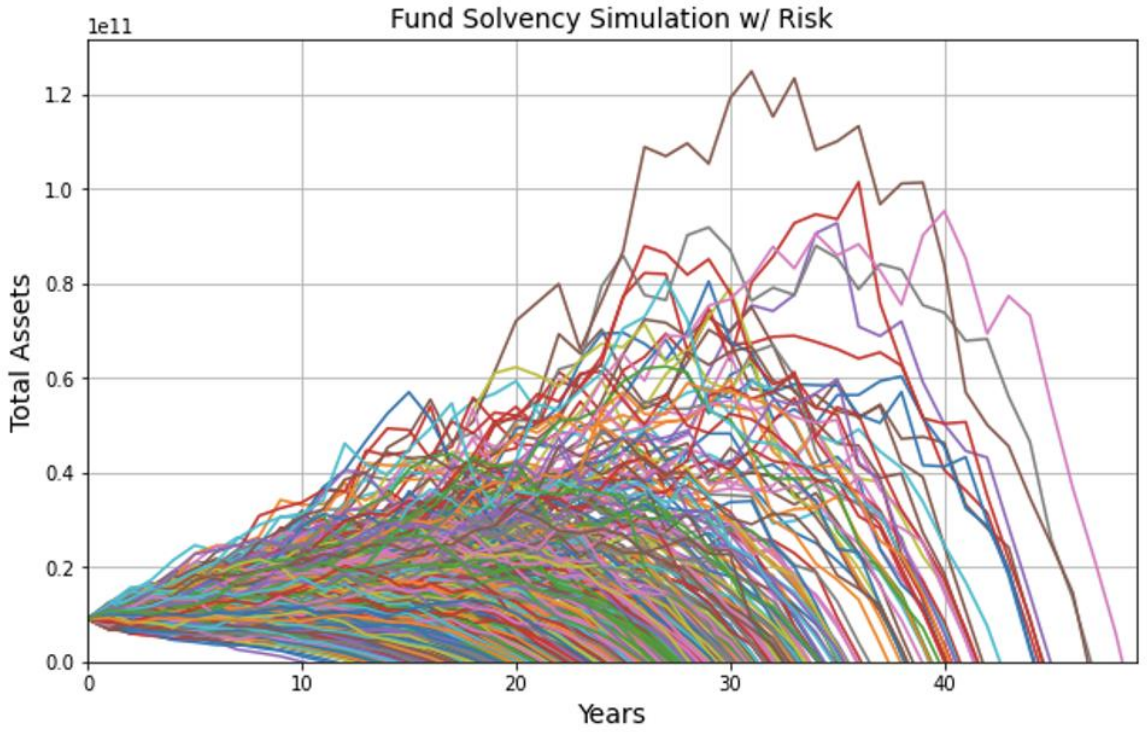


$200 Annual Million Supplement - Stats

Annual 200 Mil. Sup.

Year	Survival Rate
2017	100%
2018	100%
2019	100%
2020	100%
2021	100%
2022	100%
2023	100%
2024	100%
2025	100%
2026	100%
2027	100%
2028	100%
2029	99.90%
2030	99.69%
2031	99.08%
2032	97.97%
2033	95.22%
2034	91.96%
2035	85.15%

Portfolio Stats	
E[r]	9.34%
Std.	10.88%



$200 Million Supplement and Inflation Pegged Add. GR - Stats

200 Mil. Sup. & Infl. Peg. Add.

Year	Survival Rate
2017	100%
2018	100%
2019	100%
2020	100%
2021	100%
2022	100%
2023	100%
2024	100%
2025	100%
2026	100%
2027	100%
2028	100%
2029	100%
2030	100%
2031	99.90%
2032	99.70%
2033	98.68%
2034	96.66%
2035	94.22%

Portfolio Stats	
E[r]	9.34%
Std.	10.88%